Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the matter of	)	
	)	
Amendment of Part 97 of the	)	
Commission's Rules Governing	)	RM-8737
the Amateur Radio Service to	)	
Facilitate Spread Spectrum	)	
Communication	)	

Reply Comments by
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Introduction

I, Robert Brown, have been licensee of amateur radio station N7STU for several years. For most of this time my main operation has been on the VHF and UHF amateur bands using SSB, CW, FM, and packet modes. I have communicated with most US states and several countries on the 50 MHz band. I have communicated with 11 states, including Hawaii (~4000km) and a few EME contactson 144 MHz. I currently have equipment for the 50, 144, 432, 902, 1296, 10,000 MHz bands in addition to HF. I have plans to add 222, 2304 and 5760 MHz equipment in the near future.

Summary

I have major reservations concerning RM-8737 as written. While I strongly support the widespread use of Spread Spectrum (SS)techniques, their use with no frequency restrictions will cause major damage to weak signal terrestrial work and the understanding of VHF/UHF propagation characteristics that it supports. I urge that the Commission's relaxation of the SS Rules, as proposed by the American Radio Relay League (ARRL) on December 12, 1995, be accomplished only on specific frequency segments within the Amateur Service bands. Otherwise, as I will demonstrate below, widespread use of SS by amateur operators, which I hope will occur, will make reception of weak signals all but impossible in urban areas.

I foresee SS to be the key element which will lead to greatly increased use of the amateur microwave bands. Many, many amateurs are forced into housing that does not permit outdoor antennas. SS will permit really high data rate data communication to reach the indoor antennas these amateurs must use, because of SS's ability to overcome multipath errors. The high data rate communication will lead to an amateur computing / amateur radio synergy and impressive advances for both. However, because of the characteristics of microwave propagation, and the indoor antennas, this communication must be based on repeater stations.

To obtain a measure of the possible interference that would result from an SS station, the following examples are presented:

Example 1: (Data repeater station)

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  +20 dBW     SS station with 100 W effective radiated power(ERP)
  -50 dBW/Hz  power density if spread over 10 MHz
 -110 dB      free-space attenuation at 20 km at 435 MHz
 -160 dBW/Hz  SS signal power density at 20 km, 435 MHz

 -210 dBW/Hz  receiver noise floor with 1 dB noise figure, a very
common value for weak signal and satellite work.
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The interfering SS signal is 50 dB above the noise floor that would exist without it, and would destroy all chance for weak-signal work. If the SS station used the maximum proposed power, 100 W, and a 10 dB gain omnidirectional antenna, the interference would be 10 dB greater.

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    Example 2: (Low-power data node station)
  +10 dBW     SS station with 10 W effective radiated power,
              1 W transmitter and 10 dB gain antenna
  -60 dBW/Hz  power density if spread over 10 MHz
  -90 dB      free-space attenuation at 2 km at 435 MHz
 -150 dBW/Hz  SS signal power density at 2 km, 435 MHz

 -210 dBW/Hz  receiver noise floor with 1 dB noise figure as above
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In this case the interfering SS signal is 60 dB above the noise floor that would exist without it.

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    Example 3: (Low-power voice station)
  +10 dBW     SS station with 10 W effective radiated power,
              1 W transmitter and 10 dB gain antenna
  -50 dBW/Hz  power density if spread over 1 MHz
  -90 dB      free-space attenuation at 2 km at 435 MHz
 -140 dBW/Hz  SS signal power density at 2 km, 435 MHz

 -195 dBW/Hz  receiver noise floor with 10 dB noise figure and
feedline loss, not a "serious" weak signal station.
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In this case the interfering SS signal is 55 dB above the noise floor that would exist without it.

One does not need to consider directional antennas in the above calculations since they are lossless (approximately), and only change the places that receive interference, not the total area that receives interference. To communicate with a desired distant station, a weak signal station is as likely to have to point its antenna toward an SS station as in any other direction.

There have been claims that SS requires "milliwatts" to provide good mobile coverage. This is based on voice, not wideband data operation, and the use of a substantial number of base node stations scattered throughout the coverage area - in the style of cellular telephone systems. Each of these many voice nodes would resemble Example 3 (above), which showed very substantial interference.

The use of automatic power control may sound attractive, but may prove ineffective or unworkable in the amateur situation, because all SS stations would have to implement the same power control protocols since power control is based on continuous feedback from the receiver over a full duplex channel. The additional problem is that, if the central repeater or node station was using low power to communicate with a nearby station, distant SS stations would think the channel was unoccupied, start transmitting, and cause interference and reduced

channel capacity. Some have suggested that the power control would adjust power to suit the hardest-to-reach station, ie: the highest power.

The FCC's current SS rules, and the ARRL in Para 9, go to some length to claim that "unintentional triggering of repeater inputs" is not considered to constitute interference. It appears to me that this is prima facie evidence that they believe that SS operation will result in noise floor increases sufficient to trigger FM repeaters and completely ignore that such noise floor increases would dramatically degrade reception of weak terrestrial or satellite signals.

Why haven't there been complaints of interference from SS operation? It is likely that there have been fewer than 500 hours of SS transmission in all the years of the special authorizations, and in only a few geographic areas. I suspect that there has been no nearly-continuous 100 W ERP operation such as I foresee for the data application.

The present rules for the transmission of station identification by SS stations are inadequate. While the SS signal may occupy many megahertz, the SS station is allowed to identify by keying a narrow-band signal anywhere within the range. Finding this identification would be harder than the proverbial needle in a haystack. SS stations should be required to identify by on-off keying of their wideband SS output at a rate of 20 wpm or less at least every ten minutes. Then the SS station could be easily identified by anyone suffering substantial interference.

My Proposal

As already stated, I believe that SS operation should be encouraged. However, I contend that SS should be restricted to certain frequency segments so as to offer minimal interference to other operation. The "motherhood" statements limiting SS to operation on a non-interfering basis are essentially meaningless. Even with my identification proposal (above), I see no practical way to enforce the noninterference requirement. Who defines interference? If unwanted triggering of a repeater isn't interference, is prevention of working DX interference?

Limiting SS to certain subbands is consistent with Commission policy in the Amateur Service. I cite the fact that voice operation, VHF beacons, FM on 10 meters, and many other activities have been be limited to certain segments on the HF and VHF amateur bands for many years. SS stations, being a very wideband mode, will have significant emissions beyond their nominal bandwidth. These should be restricted by the generally accepted 40 or 60 dB down at band or subband edges.

I would like to see a great increase from the present insignificant use of SS. I have demonstrated above, however, that while SS may be compatible with relative high signal strength narrow band modes such as FM, it is not compatible with relatively weak signal modes such as terrestrial weak signal work.

To achieve the full potential of SS, and not destroy present VHF/UHF operation, I strongly recommend that SS be authorized only in the following segments of the Amateur Service bands:

905 - 928 MHz
1240 - 1260 MHz

2410 - 2450 MHz
3300 - 3445 MHz
All above 5500 except 5750 - 5770 MHz and 10.360 - 10.380 GHz.

These proposed frequencies also provide protection for existing weak signal operation near 432, 902, 1296, 2304, 3456, 5760 and 10,368 MHz, as well as amateur satellite operation.

Conclusion

I have demonstrated by the above calculations that SS will be a poor neighbor if allowed to share the same subbands as VHF/UHF weak signal operation. The Commission should follow these recommendations in formulating new SS rules designed to foster its widespread use among amateurs. I further recommend that the FCC place no greater restrictions on SS use than absolutely necessary. Such a course will foster growth of SS among amateurs in their historic pursuit of new technologies and the use of higher and higher frequencies, but not disrupt the continuation of other valuable amateur operation.

Respectfully submitted,

Robert Brown

March 11, 1996